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**MILITARY RETIREMENT: ALTERNATE FINAL PAY
AND COST OF LIVING INDEXING**

by

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**MILITARY RETIREMENT: ALTERNATE FINAL PAY AND COST OF LIVING
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ABSTRACT

This paper analyzes military retirement reform; comparing the current retirement plan, HI-3 adjusted annually by CPI-W, to proposals that change base retirement pay and/or COLA indexing. The proposed changes to base retirement pay are a HI-4 or HI-5 plan and changes to COLA indexing are to use Chained CPI or CPI minus 1 percent. The plans were modeled to estimate the present value from the perspective of the government and retiree. By implementing HI-4 or HI-5 Chained CPI the government can save an estimated \$0.3 to \$1.7 billion per retiree cohort, respectively, and would result in an average loss to the present value to the retiree of \$5,000 to \$88,000. The government is indifferent if either Chained CPI or CPI minus 1 percent plan is implemented as either plan offers equal savings. The method used to adjust COLA effects officers and enlisted differently with officers preferring CPI minus 1 percent and Chained CPI preferred by enlisted retirees. However, Chained CPI has a lower loss of present value to the individual than CPI minus 1 percent when averaged over a retiree cohort.

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LIST OF ACRONYMS AND ABBREVIATIONS

BLS	Bureau of Labor Statistics
CBO	Congressional Budget Office
COLA	cost-of-living adjustment
CPI	consumer price index
CPI-W	consumer price index - wage
CSB	Career Status Bonus
DOD	Department of Defense
HI-3	High Three Years of Pay
HI-4	High Four Years of Pay
HI-5	High Five Years of Pay
NPV	Net Present Value
OSD	Office of the Secretary of Defense
PV	Present Value
SecDef	Secretary of Defense

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I. INTRODUCTION

A. BACKGROUND

Over the past couple of years there has been an initiative from the Office of the Secretary of Defense (OSD) to decrease overhead and increase efficiency in the Department of Defense's (DOD) business operations. This initiative began in 2010 because of impending decreases to the DOD's budget in the coming years (Defense Business Board, 2011). In order to meet these initiatives of decreased overhead and increased efficiency, several studies and reform proposals have been completed on the military retirement system. The studies have recommend a wide variety of options for military retirement reform ranging from keeping the system unchanged, to simple modifications to the current system, and to a complete overhaul from a defined benefit to a defined contribution plan (Henning, Military Retirement Reform: A Review of Proposals and Options for Congress, 2011).

The reform of military compensation is still a top priority of the Secretary of Defense (SecDef) and the United States Congress (Pellerin, 2013). The SecDef reiterated this priority in his opening letter of the *Quadrennial Defense Review of 2014* stating "that we must reform Military compensation in a responsible way" (Department of Defense, 2014) The SecDef's statement echoed the actions of the United States Congress. Congress passed the Bipartisan Budget Act of 2013, which changed the way cost-of-living adjustment (COLA) is calculated. However, this was changed by S. 25 in February 2014 to apply only to members entering the military after December 31, 2013 (S. 25, 2014).

B. PURPOSE

The purpose of this thesis is to quantitatively analyze, using present value (PV), the value of military retirement. The PV is calculated for the current military retirement plans and the following purposed changes:

- Final Pay Index using High Four Years of Pay (HI-4) or High Five Years of Pay (HI-5)

- Annual Pay increase equal to Consumer Price Index (CPI) minus 1 percent from date of retirement until age 62 years. After age 62, payments are restored to the same value as if they grew at the CPI rate from the date of retirement and continue to increase at the rate of CPI.
- Annual Pay increase equal to Chained CPI from date of retirement until age 62. After age 62, payments are restored to the same value as if they grew at the CPI rate from the date of retirement and continue to increase at the rate of CPI.

My research uses the data produced from the quantitative analysis to measure the impact of these changes to valuation by individual service members, and the DOD across several ranks and years of service, at date of retirement.

C. RESEARCH QUESTIONS

1. Primary Question

What is the change in value to individual retirees from the current retirement plan to retirement plans with a change in final pay and/or COLA indexing?

2. Secondary Question

Does the change in final pay and/or COLA indexing change an individual's greatest retirement value depending on when individual chooses to retire considering their promotion date, rank, and years of service at date of retirement?

D. SCOPE AND LIMITATIONS

I review prior military retirement reforms and their implementation. I use this historical data as a foundation for the changes being proposed. The analysis of proposed changes is limited to the retirement system for active duty officers and enlisted personnel only and does not address any changes to either disability retirement or reserve officer and enlisted retirement payments. An individual's choice of when to retire is based upon many different variables. This thesis will only take into account the valuation of the different retirement plans as a factor which affects individual's choice of when to retire.

E. METHODOLOGY

I used a mathematical model based on PV to calculate the values of the current retirement system and the proposed changes to final pay and COLA indexing. These values are computed and compared across different ranks, promotion dates, and years of service at date of retirement. Chapter III discusses the methodology in greater detail.

F. ORGANIZATION OF THE RESEARCH

Chapter II gives a history of military retirement, the various reforms, and the current system. It also discusses the proposals that are used in the mathematical model.

Chapter III describes the methodology used for the mathematical model in calculating NPV for the various proposals. The determination of constants and variables for the mathematical model is discussed. Finally, the assumptions and limitations of the mathematical model are stated.

Chapter IV details the results calculated from model. This includes calculations, comparison between the proposals, and interpretation of the results.

Chapter V gives recommendations based on historical and analytical analysis of the data.

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II. HISTORY OF U.S. RETIREMENT SYSTEM AND CHANGE IMPLEMENTATIONS

A. INTRODUCTION

This chapter details the history of the military retirement system from its beginnings in colonial times to the present day. Current military retirement system plans are then reviewed in detail. Finally, the proposals analyzed in my thesis: HI-4, HI-5, Chained CPI, and the Bipartisan Budget Act are discussed.

B. OVERVIEW OF THE PENSION PLAN DEVELOPMENT

This section relies heavily upon the DOD Office of the Actuary report from 2014 entitled *Valuation of the Military Retirement System*.

1. Beginnings

Initially, military pensions were based on whether or not the member became disabled and can be traced back to English pension law. The pilgrims at Plymouth were the first colonials to provide a pension to soldiers. In 1636, the pilgrims would provide for a soldier maimed in battle for the duration of his life. The first national pension law in 1776, promised half pay for life, or the duration of disability. The first national pension law was initial administered by each individual State administered until, in 1790, pension administration was taken over by the Secretary of War (DOD Office of the Actuary, 2014).

The first pension based on service alone, regardless of disability or need, was promised by the U.S. Congress in 1780 for officers who served to the end of the Revolutionary War. Congress promised half pay for life (DOD Office of the Actuary, 2014). The promise was not fully fulfilled, however, and pension claims were settled for less than full value. As the number of living veterans from the war started to decline, Congress progressively increased the value of the pension. In 1818, an act was passed to provide Revolutionary War veterans relief if in need; in 1832, this became full pay for life regardless of need, and, in 1836, widows were included (DOD Office of the Actuary,

2014). The administration of military pensions was transferred to the newly created Department of the Interior in 1849. The Department of the Interior would continue to administer pensions until the establishment of the Veterans Administration in 1930 (DOD Office of the Actuary, 2014).

2. Civil War to World War II

The changes to the military retirement system that started during the Civil War were enacted to shape the military force. It became necessary to retire older officers who could not perform their duties in the field. The means to accomplish this was the act of August 3, 1861, allowing the voluntary retirement of officers from all branches after 40 years of service, at the discretion of the president. This was the first major retirement act not based on disability (DOD Office of the Actuary, 2014). It was later modified to also allow for retirement based on age (DOD Office of the Actuary, 2014).

In 1870, Congress established the voluntary retirement of officers after 30 years of service at 75 percent of pay, in order to facilitate a peace time drawdown, post-Civil War. For the first time, retirement payment was established at a value of 2.5 percent for each year of service. During this peace time drawdown, the first nondisability retirement was established for enlisted personnel and had the same provisions as the retirement established for officers in 1870 (DOD Office of the Actuary, 2014).

World War I brought about retirement changes to help shape the force, primarily in the Navy. The large influx of Naval officers and the limited ability to retire officers resulted in a stagnation of promotion. To alleviate this problem, promotion selection boards were established for promotion to Rear Admiral, Captain, and Commanders starting in 1916. Eligibility for the selection boards was first based on the service members' age and rank (DOD Office of the Actuary, 2014). In 1926, the eligibility criterion was changed to time of service in grade. Members not picked up for promotion were retired with a pension of 2.5 percent per year of service, not to exceed 75 percent, regardless of years of service. After World War I, the Navy continued to experience stagnation of promotion. In 1938, the solution to this stagnation was to expand the promotion board selection process to all grades above Lieutenant, add maximum years of

service for Lieutenant Commanders to Captains, and lower the voluntary retirement to 20 years of service (DOD Office of the Actuary, 2014).

3. World War II to 1980

After World War II, the military retirement system began to resemble its i present structure. In 1947, the Army and Air Force implemented a promotion selection process similar to that established by the Navy in World War I. It established a severance package for officers not selected for promotion. The severance was set at two months' pay multiplied by number of years of service, and not to exceed a total of two years of pay. One year later, for the first time ever, the Army and Air Force Vitalization and Retirement Equalization Act of 1948 unified military retirement compensation among all Services. The act also reduced severance pay to one month's pay per year of service, not to exceed one year's pay (Under Secretary of Defense for Personnel and Readiness, 2005).

After all services were unified under the same retirement system, the system did not undergo any major changes for the next 30 years. It incurred some changes to how retired pay was increased over time (DOD Office of the Actuary, 2014). Initially, retired pay increases were linked to active duty pay increases. In 1958, the method to increase retired pay was changed to a COLA increase of 6 percent This increase was roughly the increase in cost-of-living since the last time retirement pay was increased, in 1955 (DOD Office of the Actuary, 2014). This led to the first automatic yearly increase to retirement pay based on the increase in cost-of-living, in 1963 (Uniformed Services Pay Act, 1963). In 1965, the formula was modified again, to grant an increase in pay if the CPI increased by 3 percent for at least 3 months in a row (Uniformed Services Salary increase, 1965). In 1977, COLA increases were scheduled to occur twice a year, in March and September, with the increase equal to the percentage increase in CPI from the previous June to December and December to June, respectively (DOD Office of the Actuary, 2014). Pls continue to give citations for data from here onward

4. 1980 to Present

The first retirement reform to change base retirement pay, since the Army and Air Force Vitalization and Retirement Equalization Act of 1948 was enacted in December of 1980 with the Defense Officer Personnel Management Act. This changed the formula for retirement pay from final pay to the average of the highest 36 months of pay multiplied by 2.5 percent and then multiplied by years of service (DOD Office of the Actuary, 2014).

From 1977 to 1984, several changes to COLA calculations occurred. These changes involved changing the timing and number of increases that occurred per year. In April of 1984, P.L. 98-270 established COLA increases equaled the percent increase in the average of the CPIs of July, August and September over the average of the same three months from the previous year (DOD Office of the Actuary, 2014).

The Military Retirement Reform Act of 1986 changed the formula for retirement, also called the Redux formula. This formula is covered in greater detail later in this chapter. In 1999, The National Defense Authorization Act for Fiscal Year 2000 established the Career Status Bonus (CSB). This converted individuals who joined after July 31, 1986 back to the HI-3 formula with the option at 15 years of service to elect to stay on the HI-3 formula or take a lump sum bonus and convert to the Redux Formula (Under Secretary of Defense for Personnel and Readiness, 2005). The cap to not exceed a multiplier of 75 percent was removed in 2006 by the John Warner National defense Authorization Act for Fiscal Year 2007.

Between 1981 and 2000, a substantial increase in basic pay occurred. This was done to bridge the difference between military and civilian compensation (DOD Office of the Actuary, 2014). The increases in basic pay have a direct impact on the increase in retirement pay, because retirement pay is a function of basic pay.

The most recent retirement change took place in December of 2013 with the Bipartisan Budget Act of 2013. This act changed the formula for the COLA calculation, and will be detailed later in the chapter (Bipartisan Budget Act, 2013).

C. CURRENT RETIREMENT SYSTEM

1. Final Pay Plan

For individuals who joined the military prior to September 8, 1980 they are subject to the Final Pay Plan. Under this plan the retiree must complete a minimum of 20 years of service to be eligible for retirement pay. The retirement payment is calculated using the retiree's final basic pay multiplied by 2.5 percent and then multiplied again by number of years of service. The retirement pay is also protected from inflation with an annual COLA increase equal to CPI (Under Secretary of Defense for Personnel and Readiness, 2005).

2. HI-3 Plan

The HI-3 Plan was implemented for military members who joined the service after September 7, 1980. This plan is identical to the Final Pay Plan in all aspects with one exception. Instead of using final basic pay in the retirement calculation it uses the average of the highest 36 months of basic pay. This legislation was enacted because of concerns of over increasing retirement cost (Department of Defense, 1984).

3. Redux/CSB

The Redux retirement plan was introduced in July of 1986 and any individuals joining after July 31, 1986, are covered by this plan. The retired pay formula under Redux uses the same basic principle as the HI-3 and Final Pay plan, the retired base pay multiplied by a multiplier. The Redux formula used the same method as the HI-3 formula in the calculation of retired base pay, the average of the highest 36 months of base pay. The changes in the Redux plan involve the multiplier, COLA, and age of the retiree.

For the first 20 years of service each year is credited with 2 percent for a total multiplier of 40 percent. The next 10 years of service are credited at a rate of 3.5 percent. Any years of service after 30 years are credited at 2.5 percent. COLA increases are calculated by taking CPI minus 1 percent. At age 62 there is a re-computation of the retirement payments. The payment is set to equal the payment that would have been received under the HI-3 plan with COLA increases equal to CPI. However; after this

onetime adjustment the COLA increase reverts back to CPI minus 1 percent (Under Secretary of Defense for Personnel and Readiness, 2005). Table 1 displays the multiplier for the different plans.

Years of Service	Final Pay/HI-3 Multiplier	Redux/CSB Multiplier	
		Before Age 62	After Age 62
20	50.0%	40.0%	50.0%
21	52.5	43.5	52.5
22	55.0	47.0	55.0
23	57.5	50.5	57.5
24	60.0	54.0	60.0
25	62.5	57.5	62.5
26	65.0	61.0	65.0
27	67.5	64.5	67.5
28	70.0	68.0	70.0
29	72.5	71.5	72.5
30	75.0	75.0	75.0
31	77.5	77.5	77.5
32	80.0	80.0	80.0
33	82.5	82.5	82.5
34	85.0	85.0	85.0
35	87.5	87.5	87.5
36	90.0	90.0	90.0
37	92.5	92.5	92.5
38	95.0	95.0	95.0
39	97.5	97.5	97.5
40	100.0	100.0	100.0
41	102.5	102.5	102.5
42	105.0	105.0	105.0

Table 1. Military Retirement System Multipliers (from DOD Office of the Actuary, 2012)

In 1999, Congress concluded that the lesser benefits from the Redux option would lead to lower retention and poor morale based on testimony from the Joint Chiefs of Staff (Nordman, 2012). Congress decided to transition members who were governed by the Redux plan into the more generous HI-3 plan. To help offset the increased costs associated with transitioning retirees to the HI-3 plan, Congress allowed the individual to

choose between HI-3 or receive a \$30,000 bonus, at their 15 years of service. If the CSB was selected it was paid immediately and the individual was converted to the Redux plan. Once the individual made this decision it could not be changed. This is what is known as the CSB/Redux plan. If a member elected to take the CSB they are required to serve until they reach 20 years of service or forfeit the CSB (Philpott, \$30,000 Knife Cuts Careerists Retirement, 2004). Since instituting the CSB/Redux plan, overall 38 percent of members choose CSB/Redux plan with 42 percent of enlisted personnel and only 7 percent of officers choosing the plan (Cunha & Menichini, 2014).

4. Bipartisan Budget Act of 2013

The Bipartisan Budget Act of 2013 has brought about the most recent changes to the military retirement system. This act changed the way that COLA is calculated over the period of the annuity. The multiplier for retired base pay is the same as the HI-3 plan. If the retiree is under the age of 62 the COLA increase is equal to CPI minus 1 percent, the same as the CSB/Redux plan. Once the retiree reaches the age of 62 at the next adjustment of COLA the member will receive the same adjustment that members under CSB/Redux receive; however, unlike CSB/Redux further COLA increases will be equal to CPI. This change is scheduled to take effect on December 1, 2015 (Bipartisan Budget Act, 2013).

Amidst outcry from veterans' groups and others over the Bipartisan Budget Act's annual cut to COLA, Congress revisited the decision of decreased annual COLA (Associated Press, 2014). On February 15, 2014, P.L. 113-82 changed the COLA reduction by making it applicable to members that joined on or after January 1, 2014, thus grandfathering all existing members.

D. PROPOSALS

1. HI-4 and HI-5

The proposal to use HI-4 or HI-5 is a modification to the existing plan to use the average of the highest 48 months and highest 60 months of basic pay, respectively. This

would be a cost cutting effort (Concepts for Modernizing Military Retirement, 2014) similar to the one enacted in 1980 under the Defense Officer Personnel Management Act.

2. Chained CPI

CPI is the measurement of inflation computed by the Bureau of Labor Statistics (BLS). CPI is utilized by a number of federal programs for annual COLA increases. CPI is calculated by measuring the change in the cost of goods and services, defined as the market basket represents average consumer spending. A major limitation to CPI is that the market basket used in the index is based on spending patterns in the past. By using spending patterns in the past, the index does not incorporate the effects of economic substitution. Economic substitution states that as the price in good A increases the demand for good B increases because good B is cheaper. The CPI calculation uses the comparison between the current and historical price of good A. The actual cost of living increase would be the historical cost of good A compared to the current cost of good B. Because of this substitution, CPI grows faster than the actual cost of living does (Meyerson, 2010).

Because of this limitation to CPI, the BLS developed a new statistic called the Chained CPI. This statistic avoids the bias of substitution from month to month by using the market baskets from both months. This produces a lower estimate of inflation by an average of 0.3 percentage points than the consumer price index – wage (CPI_W) (Meyerson, 2010).

In 2010, the Congressional Budget Office (CBO) proposed to use Chained CPI instead of CPI-W for the indexing of COLA. The investigation evaluated the possible cost savings, if the switch was implemented. The report concluded that indexing inflation to Chained CPI in the tax code would reduce budget deficits by \$90 billion over 10 years. If the same was done for Social Security and Federal Retirement outlays over 10 year would be reduced by \$108 and \$23 billion, respectively (Meyerson, 2010).

E. SUMMARY

The military retirement system began as a necessity to compensate service members who were injured in times of war so that they could provide for themselves and their families. Over time the retirement system evolved into a defined benefit for service and ultimately a tool used to shape the force structure. Military retirement is considered a significant factor in retaining a career military force (Henning, *Military Retirement Reform: A Review of Proposals and Options for Congress*, 2011). The military retirement system has only seen minor changes since the mid-1900s by changing how COLA is applied, retired base pay, or the multiplier. These changes were implemented either because of fiscal constraints or force shaping needs.

Today members of the military fall under one of four military retirement plans: Final Pay, HI-3, Redux/CSB, or Bipartisan Budget Act of 2013. Three plans to reform military retirement were discussed: HI-4, HI-5, and Chained CPI. These reform plans are not complete reforms, but are modifications to the current system. This follows the pattern of military retirement reform of the past 60 years.

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III. METHODOLOGY

A. INTRODUCTION

Chapter III details the methodology used, NPV, description and assumptions for the variables in the calculation of NPV, and the inputs and outputs of the model.

The scope of the model only includes active duty officers and enlisted personnel. It does not include reservist, disability retirement, warrant officers, and prior-enlisted members receiving an officer commission.

B. NET PRESENT VALUE

My three main goals are to determine the difference in value to the service member and the cost to the DOD between the new policies that have been proposed and the current retirement system. To accomplish the valuation of the retirement system, the NPV method is utilized. NPV is the summation of the present value of individual cash flows for a project/investment. Therefore, the higher the NPV, the more favorable the option is to the service member and the inverse is true to the DOD as it represents a cost.

NPV accounts for the time-value of money: the notion that a dollar today does not have the same value as a dollar tomorrow. See Figure 1 for the present value formula and Figure 2 for the future value formula; these are the formulas used to account for the time-value of money, where C_t is the cash payment, r is the rate of return, and t is the number of periods. These variables are discussed in further detail later in this chapter.

$$PV = \frac{C_t}{(1+r)^t}$$

Figure 1. Present Value Formula

$$FV = C_t (1+r)^t$$

Figure 2. Future Value Formula

These formulas are used on the each payment the service member receives from the individual's retirement benefit. If the payment occurs after the retiree's date of retirement, the present value formula is used and if it occurs before their retirement date the future value formula is used.

Figures 3, 4, and 5 display the timeline of payments for the different retirement plans discussed in Chapter II. For all three figures the retirement payments are in monthly increments, C_b is the base retirement pay, and i is the inflation indexing factor. The formulas in the diagrams are explained in detail later in the chapter.

Figure 3 shows the cash flows for the HI-3, HI-4, and HI-5. These three retirement plans pay the member a monthly cash flow with a COLA increase equal to inflation once per year. This cycle continues until the death of the retiree.

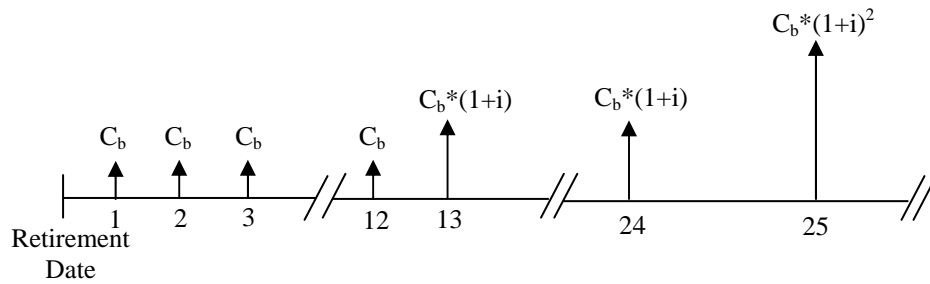


Figure 3. Cash Flows for HI-3, HI-4, and HI-5

The cash flow for the Bipartisan Budget Act retirement plan is shown in Figure 4. It is the same as the cash flows for the HI-3, HI-4, and HI-5 plans with the exception of how COLA is indexed until the retiree turns 62. Prior to the retiree turning 62, the annual COLA increase is equal to CPI-W minus 1 percent. At age 62, the retirement payment is set equal to as if annual COLA increase equaled inflation. After this catchup payment, the annual COLA increases are equal to CPI-W.

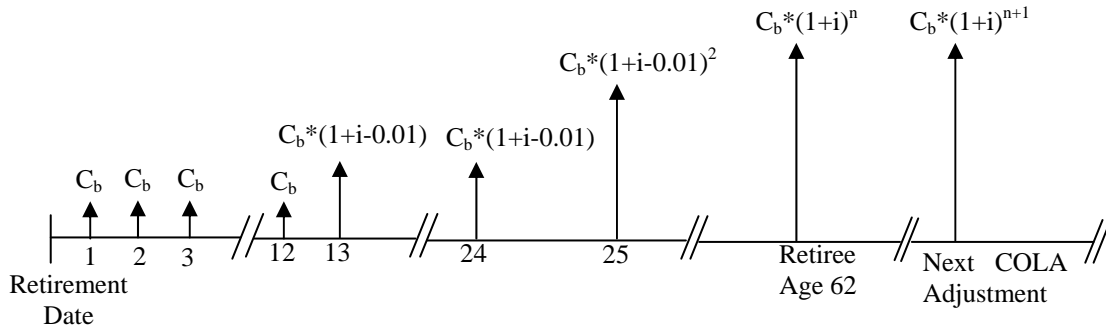


Figure 4. Cash Flows Bipartisan Budget Act

Figure 5 is the cash flow diagram for the Redux/CSB retirement plan. The diagram shows the onetime payment of the CSB at 15 years of service. Upon retirement, the retiree's retirement plan behaves exactly as the Bipartisan Budget Act Plan, until after 62. When the retiree turns 62, the individual receives the same catchup, as in the Bipartisan Budget Act, to their retirement payment. After the catchup, annual COLA increases are equal to inflation minus 1 percent.

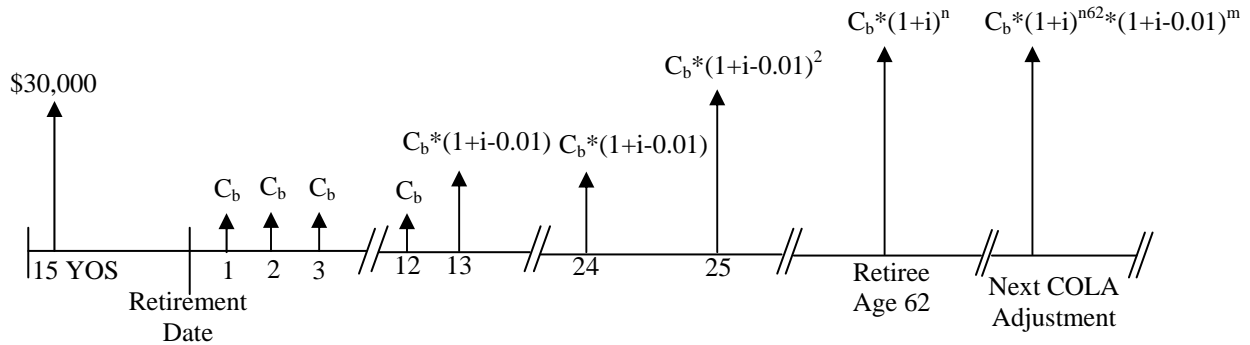


Figure 5. Cash Flows Redux/CSB

Once all of the individual payments are calculated, NPV can be calculated for each retirement plan, using the equation in Figure 6.

$$NPV = C_0 + \sum_{t=1}^T \frac{C_t}{(1+r)^t}$$

Figure 6. NPV Equation

The formula is the cash at time zero, C_0 , and the summation of the individual cash flows discounted back to time zero. Time zero is equal to the date of retirement. For all retirement plans, with the exception of Redux/CSB, C_0 is equal to zero. C_0 for the Redux/CSB option is the CSB received at 15 years of service with the value computed at date of retirement using the future value formula in Figure 2.

C. VARIABLES

This next section defines the variables used in the PV calculations. The assumptions used in calculating the variables will also be stated.

1. Cash Flows: C_b , C_i , and C_t

This section explains the three cash flows in the PV calculations, base retirement pay, increases to base retirement pay, and the initial cash flow.

a. Base Retirement Pay: C_b

Base retirement pay is the initial retirement payment, and it is calculated using the formula in Figure 7. In Figures 3, 4, and 5 base retirement pay is represented by C_b .

$$\text{retirement pay} = \text{basepay} * \text{multiplier}$$

Figure 7. Retirement Pay Formula

Base pay is a function of rank and years of service. Rank and years of service are used to determine active duty base pay. This base pay is used to calculate the average of the high 36, 48, or 60 months of pay for the HI-3, HI-4, and HI-5 models respectfully. The multiplier is a function of years of service. Depending on the retirement plan, each year of service is credited with a certain percentage. These percentages are discussed in Chapter II, and are displayed in Table 1.

I used the ranks of O-6, O-5, O-4, E-9, E-8, E-7, and E-6 when computing base pay. As of 30 September 2012, these ranks accounted for 92 percent of personnel that retired in fiscal year 2012 and 86 percent of all military retirees. Table 2 shows the number of retirees by rank (DOD Office of the Actuary, 2014).

Rank	FY2012	Total
O-6	2,105	69,824
O-5	3,058	124,288
O-4	1,994	9,228
E-9	1,974	85,399
E-8	4,833	193,501
E-7	10,328	470,797
E-6	5,561	308,616
Other	2,711	210,434
Total	32,564	1,472,087

Table 2. Number of Retirees by Rank (from DOD Office of the Actuary, 2012)

In order to ensure that average base pay is calculated accurately, a promotion date for the above ranks was established. This is to account for change in active duty base pay if the service member was promoted within the previous 36, 48, or 60 months from the individual's date of retirement. The minimum years of service for promotion are listed in Table 3.

The minimum years of service is 20 years, since this is the required time for the retirement plans to vest. If the years of service for promotion for a rank is greater than 20, the years of service at promotion is used as the minimum years of service. Also, each rank

has a maximum years of service based on high year tenure set by law. These minimum and maximums are shown in Table 3.

Rank	Promotion	Max
O-6	22	30
O-5	16	28
O-4	10	20
E-9	21	30
E-8	18	26
E-7	15	24
E-6	11	20

Table 3. Years of Service by Rank (after Department of Defense, 2009; Powers, 2006; Department of Defense, 2012; Defense Officer Personnel Management Act, 1980)

b. Increases to Base Retirement Pay: C_t

The retirement plans are protected from inflation. The cash flow diagrams in Figures 3, 4, and 5 show when and how these increases occur. For all of the plans the increase is calculated by multiplying retirement base pay by an inflation factor. The increase to the base retirement pay occurs in December of every year. The HI-3, Bipartisan Budget Act, and Redux/CSB retirement increase are captured using the formulas in figures 8, 9, and 10, respectively. Where i is an inflation factor, n is the n th time that an increase has occurred, and m is the m th time that an increase has occurred after age 62.

$$C_t = C_b (1 + i)^n$$

Figure 8. HI-3 Retirement Pay Increase Formula

$$C_t = C_b (1 + i - 0.01)^n$$

Figure 9. Bipartisan Budget Act Pay Increase Formula

$$C_t = C_b (1 + i)^{n_{62}} (1 + i - 0.01)^m$$

Figure 10. Redux/CSB Pay Increase after Age 62 Formula

The Bipartisan Budget Act of 2013 used a combination of the formulas in Figures 8 and 9. Prior to the retiree reaching the age of 62 the formula in Figure 9 is used. After age 62 is reached by the retiree, the payments are calculated using the formula in Figure 8. The Redux/CSB uses formula in Figure 9 to calculate payments prior to age 62 and the formula in Figure 10 after age 62.

The inflation factor, i , is set to CPI-W, currently used by the retirement system, or Chained CPI, proposed change to the retirement system. The value for CPI-W used is 3.0 percent, the 2014 DOD inflation assumption. This assumption is consistent with other government agencies and the average annual change in CPI for the past 32 years ending in 2012 of 2.97 percent (DOD Office of the Actuary, 2014). The value for Chained CPI used in calculations is 2.7 percent. Chained CPI is a relatively new statistic with data dating to December of 1999. Since data is not available to obtain a 32 year average, a comparison of the percent change between each year of CPI-W and Chained CPI was done from 2001 to 2012. On average, CPI-W was 0.3 percent higher than Chained CPI (Bureau of Labor Statistics, 2014). This difference was subtracted from the 3.0 percent that is used for CPI-W to obtain the 2.7 percent value for Chained CPI.

c. Initial Cash Flow: C_0

The initial cash flow is only utilized for the Redux/CSB retirement plan. The formula in Figure 2 is used to calculate the value of the \$30,000 at the date of retirement. In the formula r is the rate of return which is equal to the discount rate discussed in the next section. Setting the rate of return equal to the discount rate was done to reflect the personal time-value of money even though a higher rate of return may be achieved

through investments. t is the number of months between 15 years of service and date of retirement.

2. Discount Rate: r

Discount Rate is the rate which future cash payments are discounted to the present. When discounting cash flows, the discount rate does not only account for the time-value of money, but also the risk or uncertainty of future payments. The inclusion of the risk premium makes the discount rate a personnel choice as people have different risk tolerance. As a simple example, you expect to receive \$1000 one year from now and the discount rate is 10 percent the value of the \$1000 to you today would be \$909.09, but someone else is less risk adverse and has discount rate of 5 percent the value would be \$952.38.

Since the discount rate is a personal choice, a sensitivity analysis was done a range of discount rates. The range for this analysis is 0 percent to 20 percent. The lower bound represents money being equal regardless of time and the upper bound is the higher end of personnel discount rates (Cunha & Menichini, 2014).

There are two perspectives for the value of military retirement: the retiree and the government. The difference in these perspectives is the choice of the discount rate. For the retiree, Cunha and Menichini estimated personal discount rates the average for officers 6.49 percent and enlisted 10.05 percent (Cunha & Menichini, 2014). The government uses a discount rate of 5.50 percent. The 5.50 percent assumes a real interest rate of 2.50 percent, historical trend of government trust fund earnings, and the inflation rate of 3.00 percent discussed earlier (DOD Office of the Actuary, 2014)

The retirement payments are paid out monthly, so it is assumed that the discount rate is compounded monthly. When using the formulas in Figure 1 and 2, r is divided by 12 and t is in terms of months.

3. Time of Cash Flow: t

The variable t is the time interval at which the cash flow is paid. It starts at time interval one, first retirement payment, and ends at the n th interval at the service member's

death. In order to determine the nth interval two assumptions were made; the age the service member joined the service and the service member's life expectancy. It is assumed that individuals join the military at age 18 for enlisted service and at age 22 for commissioned service. The four year difference is caused by the requirement for officers to obtain a bachelor degree. Table 4 displays the life expectancy used by the DOD. The average life expectancy for an officer is 84.25 years and for enlisted is 79.75 years.

	Officer	Enlisted
Male	84	79
Female	84.5	80.5

Table 4. Military Retiree Life Expectancy (from DOD Office of the Actuary, 2012)

Utilizing these assumptions, the calculation for nth payment is shown in Figure 11.

$$\text{Nth} = \text{Life Expectancy} - (\text{Age Joined} + \text{Service Time})$$

Figure 11. Nth Payment Formula

D. MODEL, INPUTS, AND OUTPUTS

The model was built using MATLAB. MATLAB was chosen because it is a programming language that allows for numerical computation, visualization, and programming. It allows for matrix manipulation, making the generation and comparison of different scenarios easier. The formulas and assumptions discussed earlier were built into a mathematical model using MATLAB in order calculate retirement values for different scenarios. The mathematical model code is in Appendix B.

An input matrix was created to build the different scenarios that were analyzed. Figure 12 shows the input matrix for the model. The input matrix was comprised of many columns; each represents a unique retirement scenario.

$$inputs = \begin{bmatrix} \text{Rank} \\ \text{Months of Service} \\ \text{Date of Promotion} \\ \text{Discount Rate} \end{bmatrix}$$

Figure 12. Inputs to the Model

Figure 13 displays the output matrix of the model. Each row in the matrix corresponds to one of the retirement plans being analyzed and each column of the matrix corresponds to the scenario in the same column as the input matrix. The output matrix is used to compare between scenarios and plans.

$$outputs = \begin{bmatrix} \text{HI-3} \\ \text{HI-3 CPI} \\ \text{HI-3 Chained CPI} \\ \text{HI-4} \\ \text{HI-4 CPI} \\ \text{HI-4 Chained CPI} \\ \text{HI-5} \\ \text{HI-5 CPI} \\ \text{HI-5 Chained CPI} \\ \text{Redux/CSB} \end{bmatrix}$$

Figure 13. Output from the Model

E. SUMMARY

This chapter explained NPV and how it was used to build the mathematical model used to calculate the value of retirement systems over a variety of scenarios. The variables used in the model were defined and the assumptions behind those definitions are explained. Finally the rational for choosing the program used to create the mathematical model and how it was used to create the different scenarios for comparison was detailed.

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IV. ANALYSIS OF RESULTS

A. INTRODUCTION

This chapter discusses the results from the PV calculations for the retirement compensation proposals discussed in Chapters II and III. The savings to the government and the value lost to the individual retiree is examined. The effects of discount rate, promotions, rank, and years of service have on the retiree's retirement are considered. Finally, recruiting and retention issues are discussed.

B. VALUATION

The base valuation used for comparison is the HI-3 retirement plan. As stated in Chapter II, in the current retirement system the HI-3 is chosen at a rate of 62 percent amongst retirees. Also, amongst the proposed alternatives the HI-3 plan has the highest valuation because each alternative either reduces base retired pay, COLA, or both.

Table 5 displays the estimated valuation of the HI-3 plan in millions of dollars for one year's worth of retirees based on FY 2012 retirement numbers (DOD Office of the Actuary, 2013). The total number of retirees used was 25,755 with 5,827 officers and 19,928 enlisted. A breakdown by rank and years of service is in Appendix A. The government is concerned with the total amounts under the government discount rate because this is what the government estimates that it will have to spend. The individual is concerned with the amount per retiree using the retiree discount rate because this is what the average retiree would value their retirement.

	Government Discount Rate of 5.50%			Retiree Discount Rate 6.49% Officers and 10.05% Enlisted		
	Officer	Enlisted	Total	Officer	Enlisted	Total
Total	\$8,195	\$14,065	\$22,260	\$7,023	\$7,465	\$14,488
Per Retiree	\$1.41	\$0.71	\$0.86	\$1.21	\$0.37	\$0.56

Table 5. HI-3 Valuation in Millions of Dollars

The difference in valuation between the government and the individual is due to different discount rates. The government uses a discount rate of 5.50 percent, and the

retiree discount rates used are 6.49 percent for officers and 10.05 percent for enlisted. As discussed in Chapter III, the rates reflect estimates for the average discount rates for officers and enlisted. The larger difference in valuation between the government and enlisted retiree is because of the larger variation in discount rate with the enlisted retiree rate being approximately twice that of the governments.

Table 6 shows the difference from the HI-3 plan, as presented in Table 5, for each of the proposed retirement plans for one year's worth of retirees. The savings to the government is the aggregate PV of HI-3 minus the PV of the proposed plan at the government discount rate. The savings are shown in millions of dollars. The loss of value to the individual is the average decrease in PV to each retiree and is shown in thousands of dollars.

	Savings to Government (Millions of \$)			Loss of Value to Individual Retiree (Thousands of \$)		
	Officer	Enlisted	Total	Officer	Enlisted	Total
HI-3, CPI-1%	\$249	\$703	\$953	\$38	\$19	\$24
HI-3, Chained	\$345	\$608	\$953	\$47	\$11	\$19
HI-4	\$119	\$200	\$319	\$17	\$5	\$8
HI-4, CPI-1%	\$365	\$894	\$1,258	\$55	\$24	\$31
HI-4, Chained	\$459	\$800	\$1,258	\$64	\$16	\$27
HI-5	\$294	\$465	\$758	\$43	\$12	\$19
HI-5, CPI-1%	\$534	\$1,145	\$1,679	\$80	\$31	\$42
HI-5, Chained	\$626	\$1,053	\$1,679	\$88	\$23	\$38
Redux	\$479	\$1,037	\$1,516	\$67	\$(3)	\$13

Table 6. Change in Valuation for Retirement Plans: Savings to Government in Millions of Dollars and Loss to Individual in Thousands of Dollars

By implementing one of the plans in Table 6, the government can save an estimated 0.3 to 1.7 billion dollars per retiree cohort. The savings seen by the government will result in an average loss of value to the retiree of \$5,000 to \$88,000. The \$3,000 average increase for enlisted who chose Redux/CSB is misleading because only 40 percent of the enlisted retirees would receive an increase in retirement value. The reason why only 40 percent of enlisted retirees benefit from Redux/CSB but the average is a

gain in retirement value is because of the large variation in Redux/CSB value. The two extremes under the Redux/CSB plan are an E-6 that retires with 20 years of service, and an E-9 with 30 years of service would receive a decrease of \$46,000 and an increase of \$120,000 in retirement value, respectively. Since the enlisted Redux/CSB average is an increase, for every E-9 that retires with 30 years of service, an average of 2.5 E-6s with 20 years of need to retire to offset the increase, a ratio of 40 percent.

An additional observation from Table 6 is that the smallest savings to the government and smallest loss of value to the retiree occur when retired base pay is decreased. The largest savings occur when there is a change to the COLA indexing. This is because of the power of compounding interest. Also the savings to the government for the Chained CPI or CPI minus 1 percent models are equal in total value but differ in how they affect officer and enlisted retirees. However, Chained CPI and CPI minus 1 percent are not equal in loss of value from the retiree's perspective. Figures 14 and 15 display the value of the different retirement plans verse years of service for an O-5 at a discount rate of 5.5 percent and Figures 16 and 17 are at the same discount rate for an E-7. The figures reinforce the savings trends displayed in Table 6.

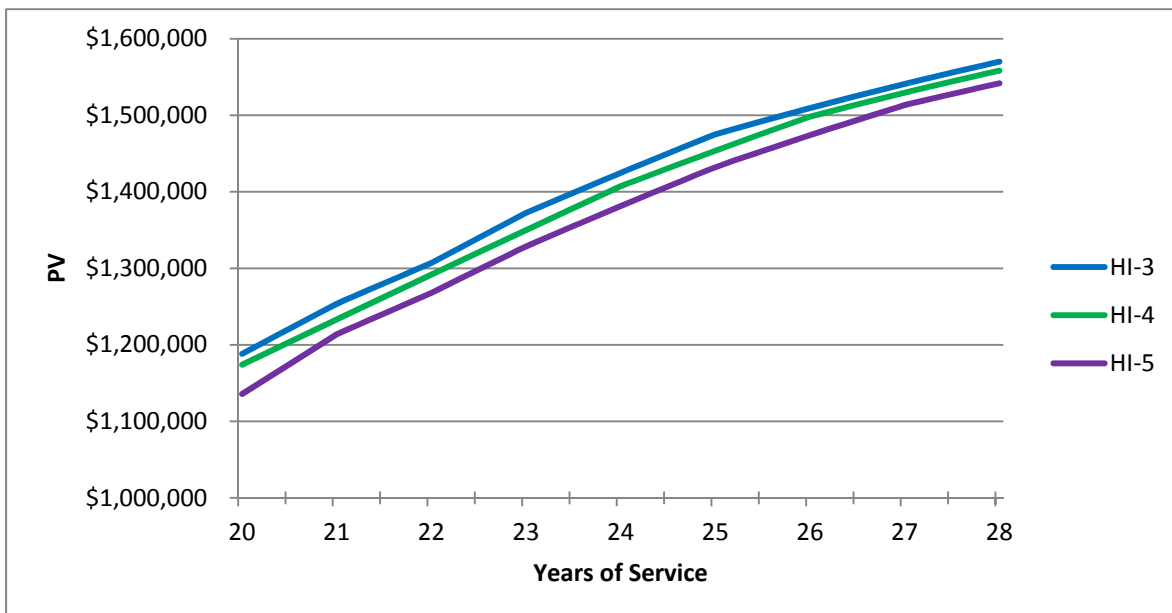


Figure 14. O-5 Change in Retirement Base Pay at 5.5 percent Discount Rate

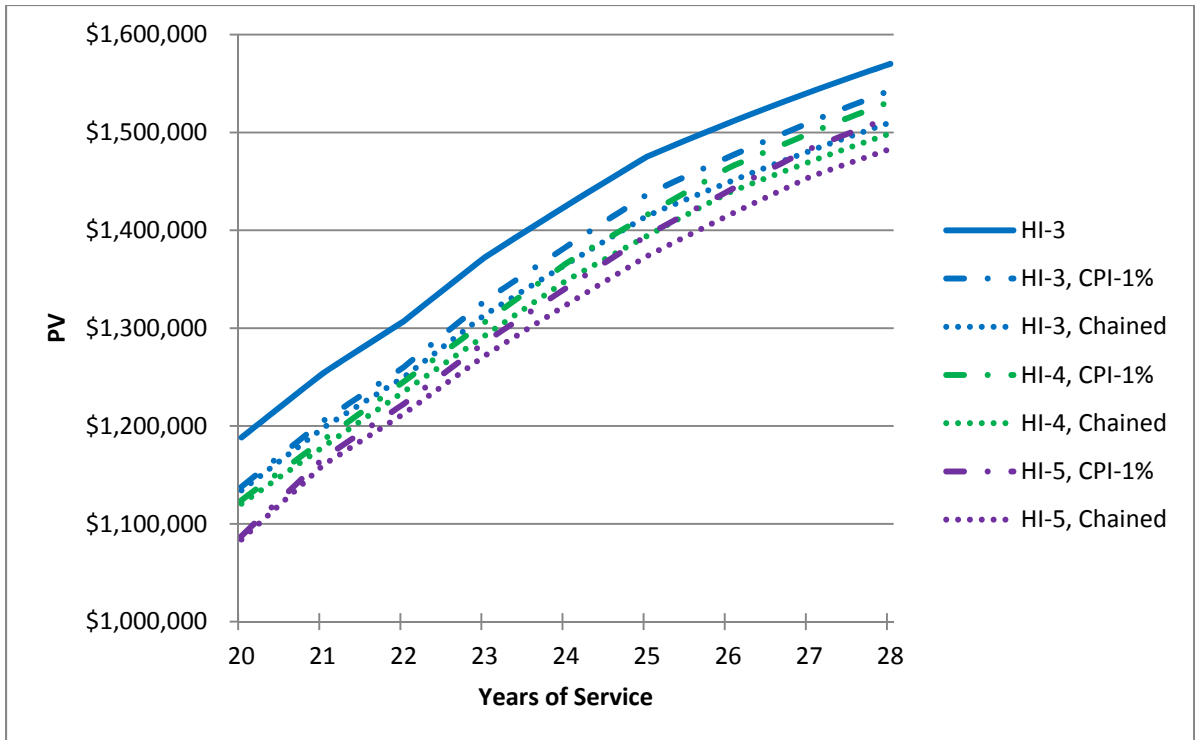


Figure 15. O-5 Change in COLA Index at 5.5 percent Discount rate

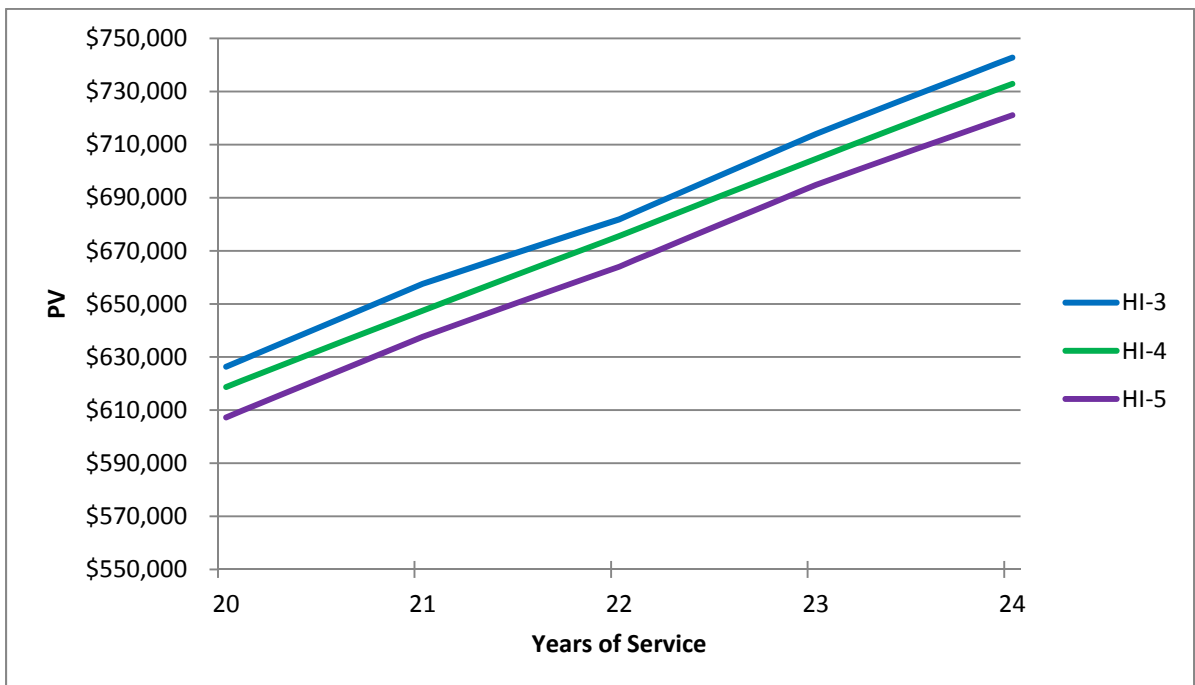


Figure 16. E-7 Change in Retirement Base Pay at 5.5 percent Discount Rate

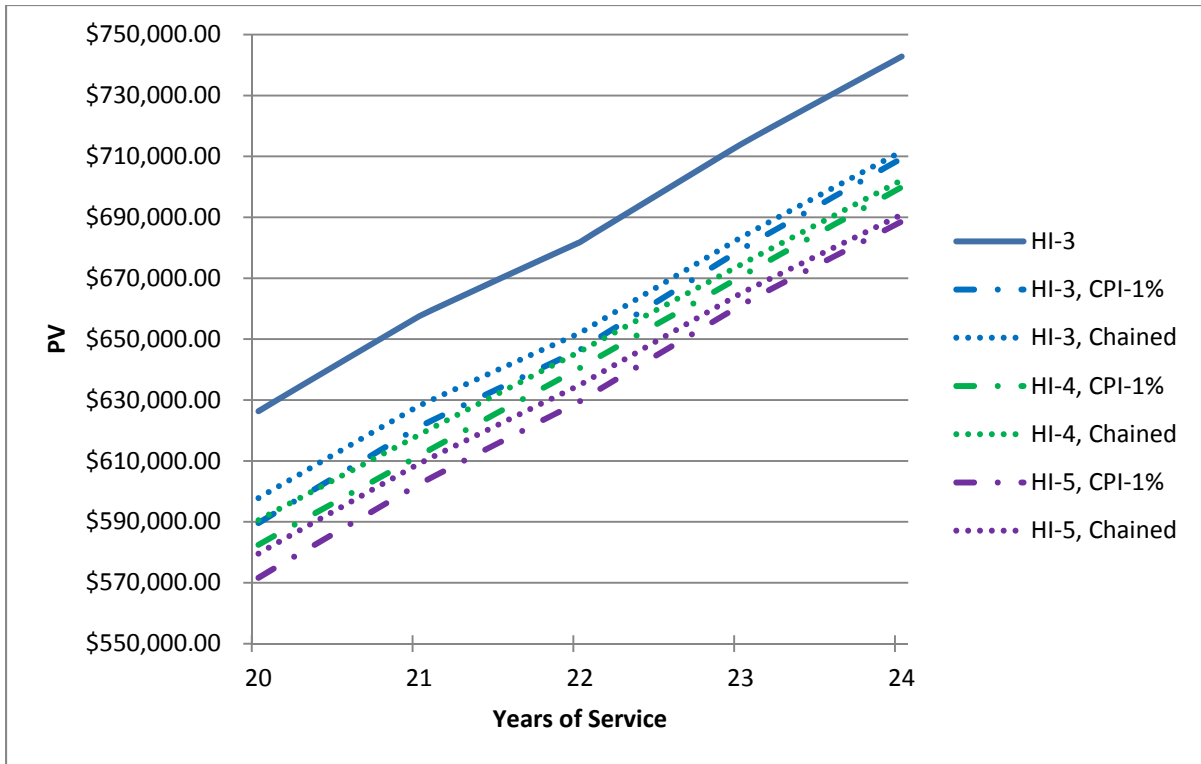


Figure 17. E-7 Change in COLA Index at 5.5 percent Discount Rate

From the perspective of the government, plans that use Chained CPI are more favorable for officers and those that use CPI minus 1 percent are more favorable for enlisted. This relationship is seen in Figures 18 and 19, the difference from HI-3 for an O-5 and E-7, respectively. A higher value in these figures represents greater loss of value compared to the HI-3 plan.

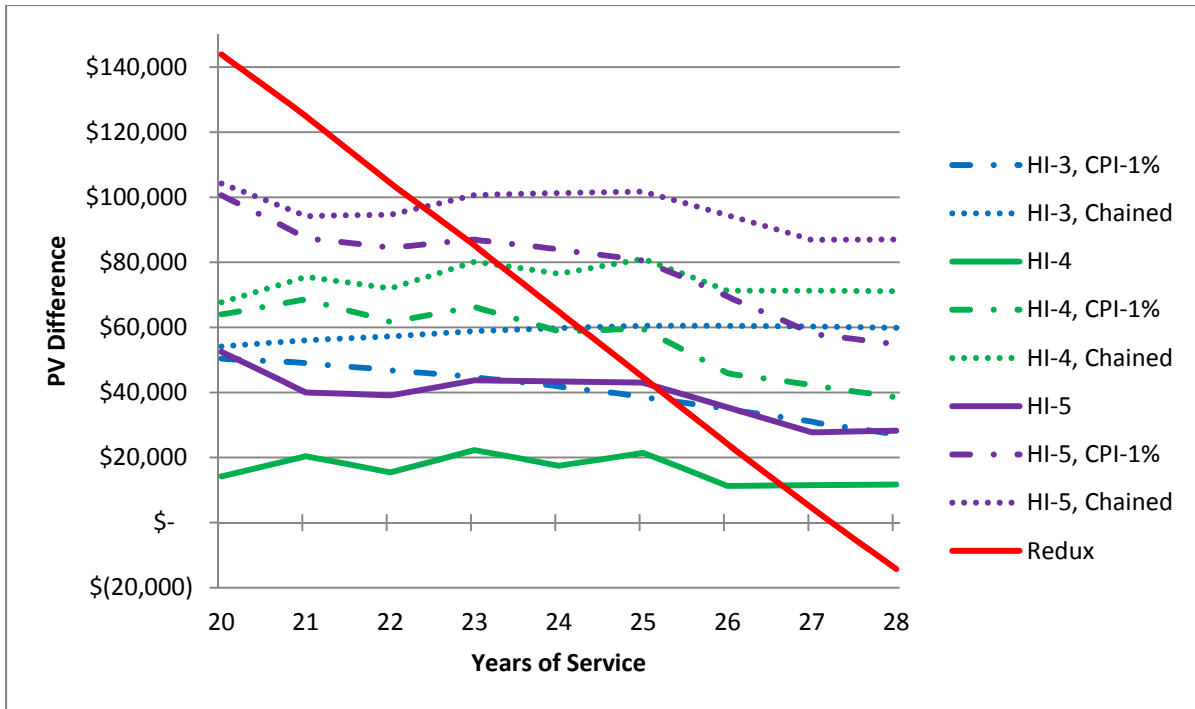


Figure 18. O-5 Difference from HI-3 at 5.5 percent Discount Rate

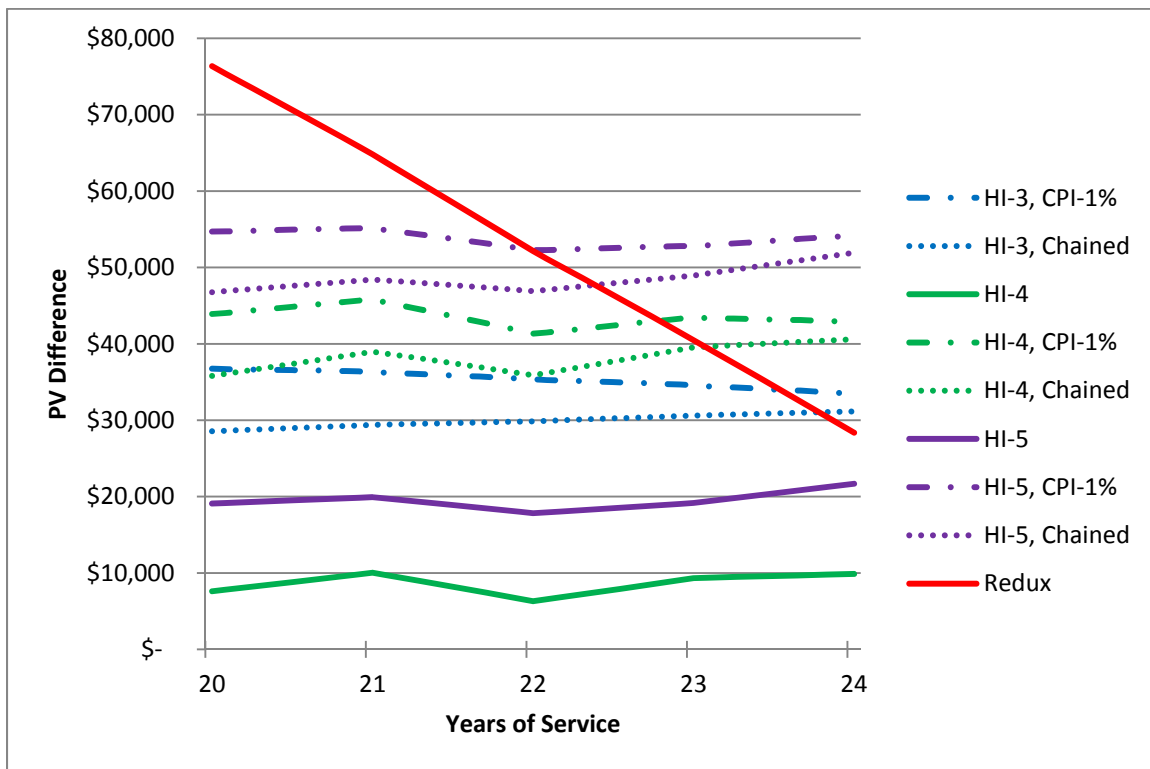


Figure 19. E-7 Difference from HI-3 at 5.5 percent Discount Rate

In Figure 18, the difference from HI-3 for retirement plans that use Chained CPI increases and CPI Minus 1 percent plans decrease as years of service increase. The same relationship is seen in Figure 19, however, Chained CPI plans start with smaller difference from HI-3 than the CPI minus 1 percent plans.

The first factor that causes the difference between officer and enlisted Chained CPI and CPI minus 1 percent relationship is enlisted members retire at a younger age on average. The earlier retirement age, of an enlisted member, results in more COLA increases being calculated at the lower CPI minus 1 percent rate. Secondly, the lower life expectancy, for enlisted members, 80 years of age verse 84 years of age for an officer. The lower life expectancy results in 48 fewer payments after age 62, when the CPI minus 1 percent plan is adjusted to equal the HI-3 plan and continue to increase annually at CPI. Finally, the difference in discount rates contributes to this relationship. Enlisted members have a higher discount rate on average than officers, resulting in a lower PV for future payments.

C. INDIVIDUAL PREFERENCE

As discussed earlier in this chapter, the preference for all retirees would be the HI-3 plan. This section will discuss different scenarios that would change the retiree's preference between the alternatives. The figures in this section show the difference from the HI-3 plan, thus a lower PV difference equates to a PV.

1. Discount Rate

As discussed in Chapter III, an individual's discount Rate is a personal preference and varies. Figure 20 and 21 show how the difference from HI-3 changes with respect to the discount rate for an O-5 and E-7, respectively, both with 20 years of service. In both figures, as the discount rate increases above 15 percent value of the plans become more with the exception of Redux/CSB. Redux/CSB continues to increase in value because of the CSB, which increase in value as discount rate increases.

For an O-5 retiring with 20 years of service, every retirement option at some discount rate has a greater valuation than at least one other option. The exception being

that the HI-4 plan is always a superior option as seen in Figure 20. At a discount rate of 6.0 percent is when Chained CPI becomes a better option than CPI minus 1 percent options when compared using the same base retirement pay calculation, i.e. HI-4 to HI4.

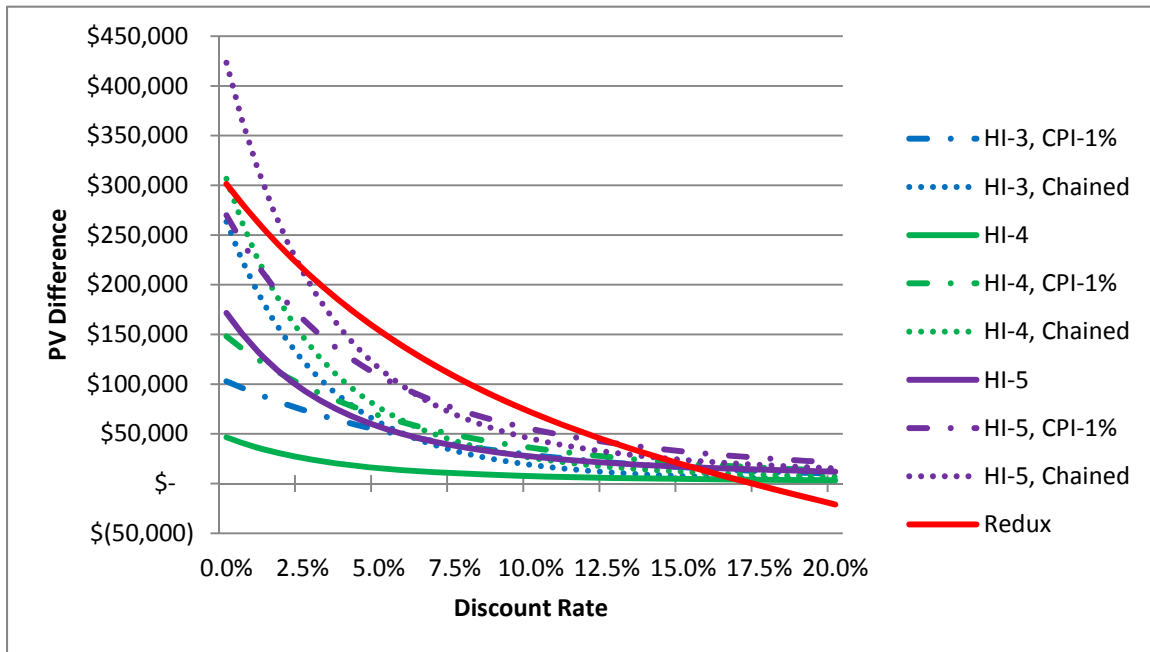


Figure 20. O-5 with 20 Years of Service Difference from HI-3 vs Discount Rate

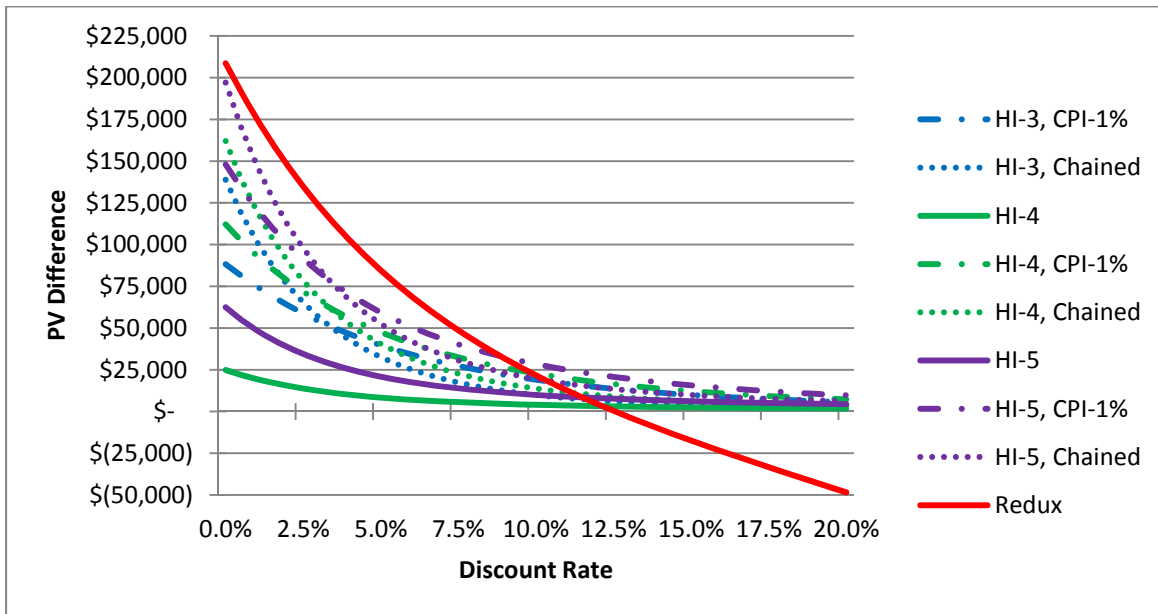


Figure 21. E-7 with 20 Years of Service Difference from HI-3 vs Discount Rate

For an E-7 the point at which Chained CPI becomes a better option than CPI minus 1 percent is at a discount rate of 3.5 percent. Also HI-5 is the second best option until a discount rate of 10 percent.

2. Rank and Years of Service

Rank and Years of Service have an impact on which plan would be the best choice for an individual. For all ranks HI-5 Chained and HI-5 CPI minus 1 percent result in a lower PV than the other plans for the individual with the exception of E-7. For an E-7, HI-5 Chained CPI has a higher PV than HI-4 CPI minus 1 percent at all years of service. For officers, HI-5 CPI minus 1 percent results in a higher PV than HI-4 Chained CPI when the retiree is closer to their high year tenure. Enlisted Retirees see a higher value for HI-5 Chained CPI at the first year of retirement eligibility.

Figures 22 and 23 graph the difference from HI-3 for the different retirement plans for an O-6 and E-9, respectively. Both of these graphs display trends that occur across all ranks.

In Figure 22, the retiree was promoted to O-6 at 22 years of service. The plans that use HI-4 or HI-5 loses value compared to HI-3 for the first three years, as shown by the increase in the difference between the plans and HI-3. For the first three years after promotion, HI-3 average increases at a faster rate because it uses fewer years to calculate base retirement pay, resulting in fewer years at the lower pay grade being included in the average. After the three years, the HI-3 rate of increase slows because the average is taken over one pay grade. At this point HI-4 and HI-5 regain the lost value because these plans base retirement pay are increasing at a faster rate. The HI-4 and HI-5 plans include pay at the lower rank in their calculation of retirement base pay. For the retirement base pay to only include the current rank, it takes an additional one year for HI-4 and two years for HI-5.

Both Figure 22 and 23 displays a two year cycle of HI-4 and HI-5 gaining and losing value compared to HI-3. Active duty pay increases with every two years of service. So depending on the retirees years of service the HI-4 and HI-5 base pay

calculation may bridge between two or three of these pay increase, where the HI-3 plan will only bridge one or two of these pay increases.

Another trend is that as the retiree's rank increases the years of service for Redux/CSB to break even decreases. The graphs for O-5, O-5, E-8, E-7, and E-6 are in Appendix A.



Figure 22. O-6 Difference from HI-3 at 6.49 percent Discount Rate

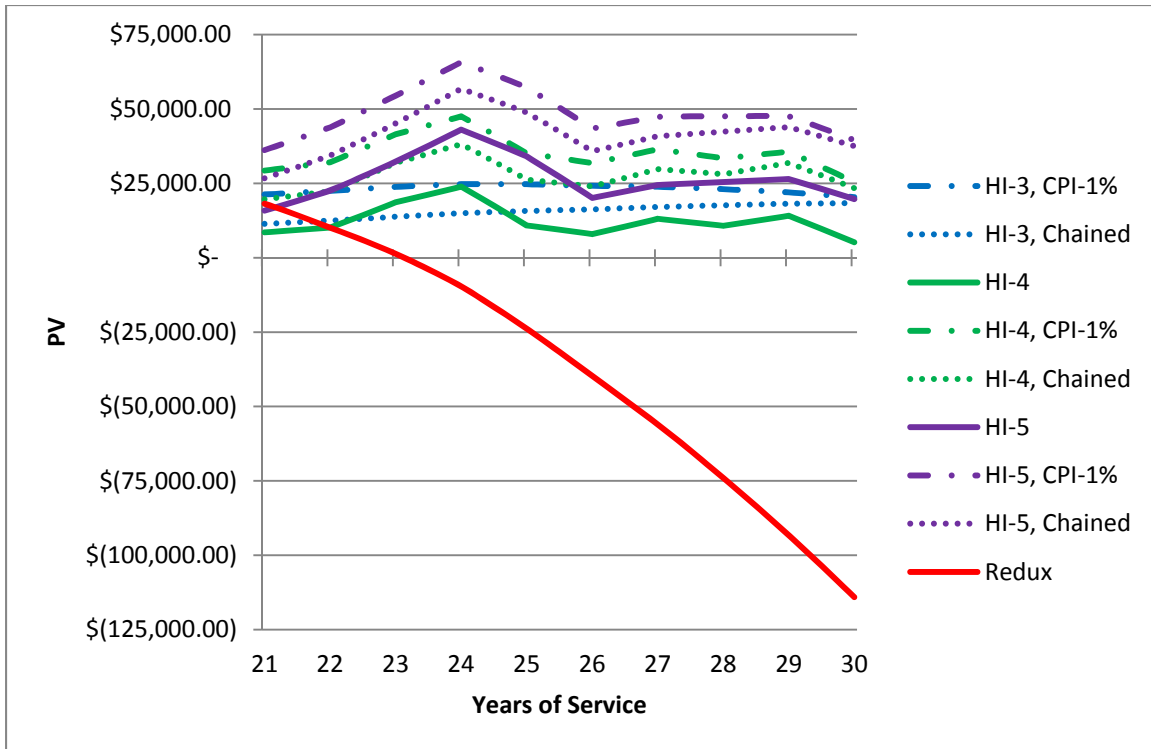


Figure 23. E-9 Difference from HI-3 at 10.05 percent Discount Rate

Table 7 presents individual retirement values at 20 years of service for different ranks. E-9 and O-6 are at 21 and 22 years of service respectively since this is the average years of service required for promotion to these ranks.

	E-6	E-7	E-8	E-9*	O-4	O-5	O-6**
HI-3	\$277	\$324	\$346	\$380	\$908	\$1,006	\$1,114
HI-3, CPI-1%	\$261	\$305	\$326	\$359	\$868	\$962	\$1,072
HI-3, Chained	\$269	\$314	\$336	\$369	\$870	\$964	\$1,069
HI-4	\$275	\$320	\$337	\$372	\$900	\$994	\$1,101
HI-4, CPI-1%	\$259	\$301	\$317	\$351	\$860	\$951	\$1,059
HI-4, Chained	\$266	\$310	\$327	\$361	\$862	\$953	\$1,056
HI-5	\$271	\$314	\$327	\$365	\$886	\$962	\$1,080
HI-5, CPI-1%	\$255	\$296	\$308	\$344	\$847	\$920	\$1,040
HI-5, Chained	\$263	\$304	\$318	\$354	\$849	\$922	\$1,037
Redux	\$266	\$303	\$320	\$362	\$799	\$881	\$1,025

Table 7. Retirement Value at 20 Years of Service in Thousands of Dollars.

*E-9 value for 21 YOS, **O-6 value for 22 YOS

D. ENLISTMENT AND RETENTION

The implementation of any of the proposals would likely raise questions about enlistment and retention since all of the proposals have a value less than the current retirement system. Table 8 shows the decrease in value to the member as a percentage of the HI-3 value and a decrease in value received each month over an assumed 40 years of retirement payments.

	Percent Decrease from HI-3			Decrease in the Value per Month of Retirement		
	Officer	Enlisted	Total	Officer	Enlisted	Total
HI-3, CPI-1%	3.19%	5.11%	4.18%	\$80	\$40	\$49
HI-3, Chained	3.89%	2.93%	3.39%	\$98	\$23	\$40
HI-4	1.45%	1.42%	1.44%	\$36	\$11	\$17
HI-4, CPI-1%	4.59%	6.46%	5.56%	\$115	\$50	\$65
HI-4, Chained	5.28%	4.31%	4.78%	\$133	\$34	\$56
HI-5	3.58%	3.30%	3.44%	\$90	\$26	\$40
HI-5, CPI-1%	6.66%	8.25%	7.48%	\$167	\$64	\$88
HI-5, Chained	7.33%	6.13%	6.71%	\$184	\$48	\$79
Redux	5.54%	-0.76%	2.30%	\$139	\$(6)	\$27

Table 8. Percent Decrease and Monthly Value Decrease as Compared to HI-3

From table 6, the DOD could save an estimated \$953 million per cohort, by switching to HI-3 Chained CPI plan. An individual's retirement value would have to take an average decrease of 3.39 percent to achieve this savings. The DOD could save an additional \$300 million by switching to HI-4 Chained CPI plan and an additional 1.39 percent decrease in average individual retirement value would be needed. This overall decrease is likely to lead to decreases in retention and enlistment.

Also with O-6, E-9, and E-8, individuals may decide to stay in longer if a plan that calculates retirement base pay with HI-4 or HI-5 is chosen. When using HI-4 or HI-5, the individual would need to stay one or two years longer, respectively, after a promotion than under the HI-3 plan in order to reduce the decrease in average retired base pay.

E. SUMMARY

This chapter compared the PV of the current retirement system to the proposals discussed in Chapter II. If the DOD were to implement one of these proposals it would be able to save an estimated \$300 to \$1700 million per year. Next the effects to individual retirees were analyzed. It was determined that the HI-5 Chained CPI and HI-5 CPI minus 1 percent rarely outperformed any other plan from the retiree's perspective but achieved the largest savings from the governments point of view. Also Chained CPI and CPI minus 1 percent plans affected enlisted and officers differently with enlisted preferring the Chained CPI plans, based off of PV. Promotions and the pay increases every two years have a greater impact on retirement value when using HI-4 or HI-5 compared to HI-3. Finally, a decrease in enlistment and retention might occur as the decrease in value exceeds some individuals opportunity cost threshold. Also, an individual's choice on when to retire are likely to change if HI-4 and HI-5 plans are implemented due to the number of years used to calculate retirement base pay.

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V. CONCLUSION

My study was initiated to analyze the change in value from the current military retirement system to proposals that change retirement base pay and/or COLA. The PVs were calculated for each proposal and compared to the HI-3 retirement plan with a range of savings to the government from a low of \$0.3 billion to a high of \$1.7 billion implementing the HI-4 and HI-5 Chained CPI respectively. The individual retiree would see an average decrease in retirement value from a low of 1.44 percent to a high 6.71 percent using these proposals. The method used to adjust COLA affects officers and enlisted differently with officers preferring CPI minus 1 percent and Chained CPI preferred by enlisted retirees.

A second goal of my thesis was to evaluate the effects that promotion date, rank, and years of service at date of retirement have on an individual's retirement value. When a retirement plan changed retirement base pay to HI-4 or HI-5 the promotion date and years of service had a greater impact on retirement value than HI-3. Also, an individual's choice on when to retire will change if HI-4 and HI-5 plans are implemented due to the number of years used to calculate retirement base pay.

A third goal was to evaluate the effects on enlistment and retention. Retention and enlistment would likely be negatively affected by switching to one of the proposals because all plans result in a decrease of value to the individual. The analysis on retention effects was limited because present value is the sole factor considered.

In order to balance savings to the government and loss of value to the individual, I suggest that DOD should implement a plan that uses Chained CPI. The savings to the government is the same using Chained CPI or CPI minus 1 percent and the average loss of value to the individual retiree is less using Chained CPI. I also suggest that the DOD, in conjunction with Chained CPI, should use HI-4 or HI-5 proposals. The DOD would save an estimated maximum of \$1.7 billion dollars per retiree cohort at an average loss of value to the retiree of 6.71 percent.

The scope and assumptions made in my study address a majority of military retirees. In order to understand the full effects of implanting the proposals further study would have to be done for reservists, prior enlisted, warrant officers, and disability retirement. My thesis uses the retirement value as the sole factor an individual considers when they decide to retire. This is a simplification of that decision process and other such as job stressors, quality of life, etc. need to be included to understand the true magnitude of effect that switching the retirement system would have on the retirement decision.

Results from my thesis also produced additional opportunities for further study. With different proposals in my study affecting groups of retirees differently, a study on the feasibility and practicality of switching from a one size fits all retirement benefit to a system that allows for personal choice or targets specific groups of retirees would be beneficial. Finally, the savings occurred by switching COLA to Chained CPI demonstrated the large savings that can be achieved with a simple change. This begs the question of what savings could be achieved if the DOD or all U.S. government agencies changed inflation indexing to Chained CPI from traditional CPI.

APPENDIX A. SUPPLEMENTAL TABLES AND FIGURES

A. TABLE

YOS	O-6	O-5	O-4	E-9	E-8	E-7	E-6
20	0	988	1133	0	1032	4012	4163
21	0	498	0	60	501	1600	0
22	69	483	0	73	489	1350	0
23	86	309	0	74	394	1034	0
24	148	214	0	92	416	1740	0
25	217	129	0	134	399	0	0
26	288	117	0	183	1062	0	0
27	276	82	0	158	0	0	0
28	187	96	0	179	0	0	0
29	149	0	0	161	0	0	0
30	358	0	0	622	0	0	0
Totals	1778	2916	1133	1736	4293	9736	4163

Table 9. Retirees by Rank and Years of Service

B. FIGURES

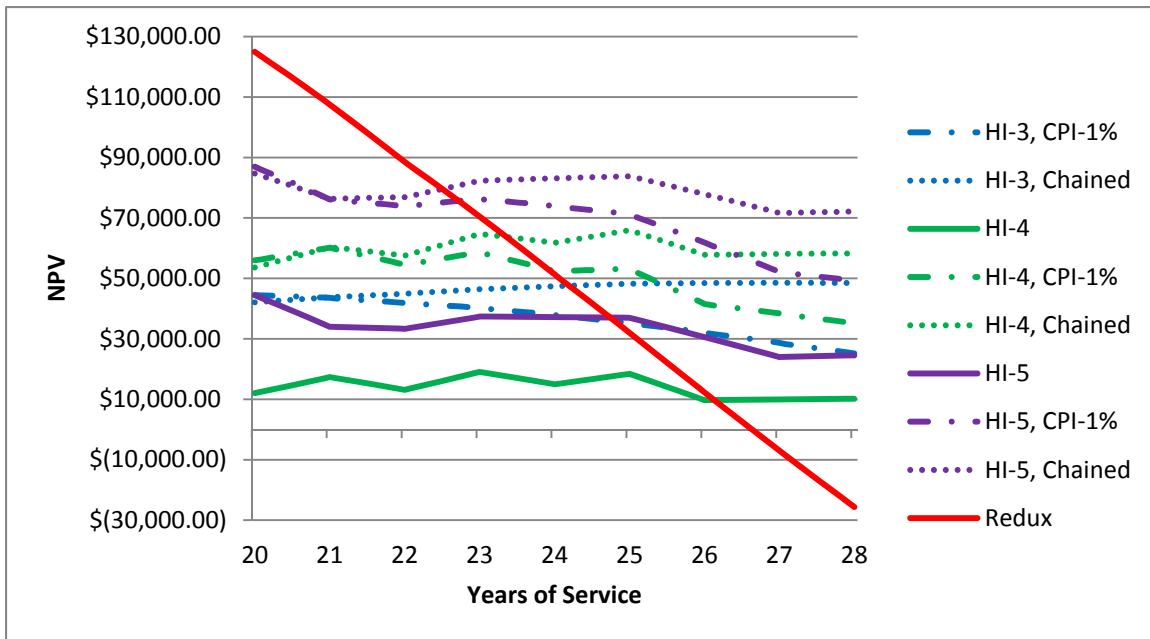


Figure 24. O-6 Difference from HI-3 at 6.49 percent Discount Rate

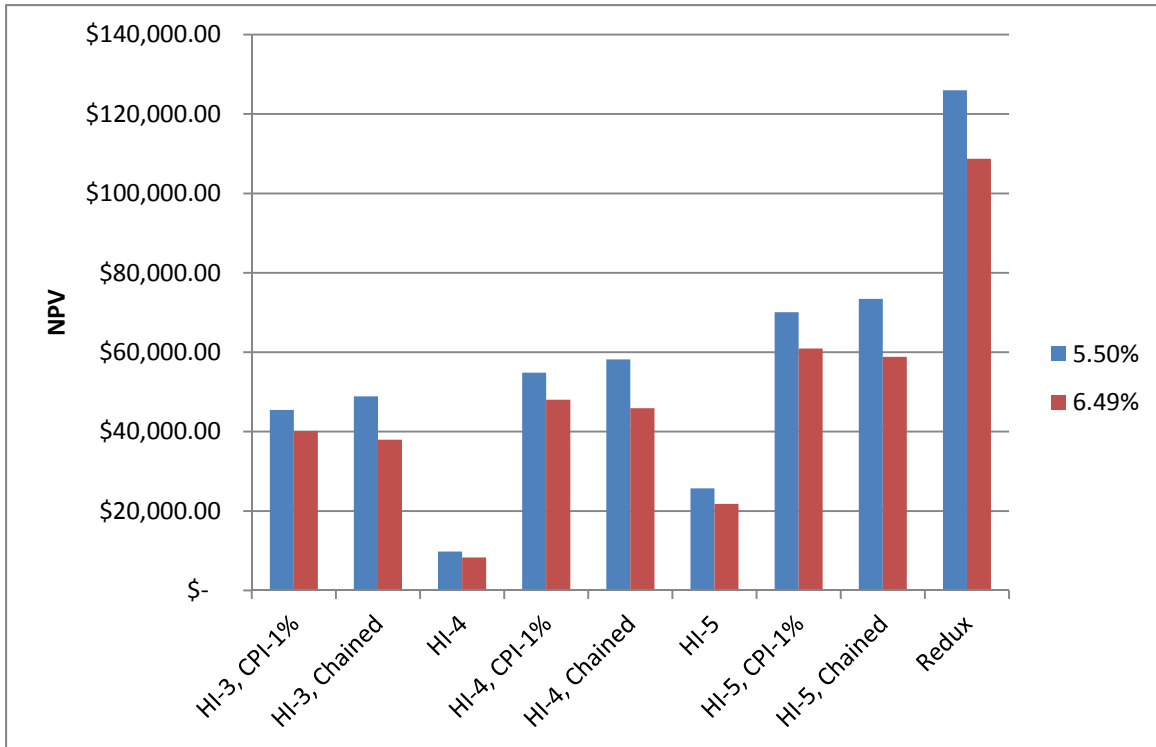


Figure 25. O-4 Difference from HI-3 at 20 Years of Service

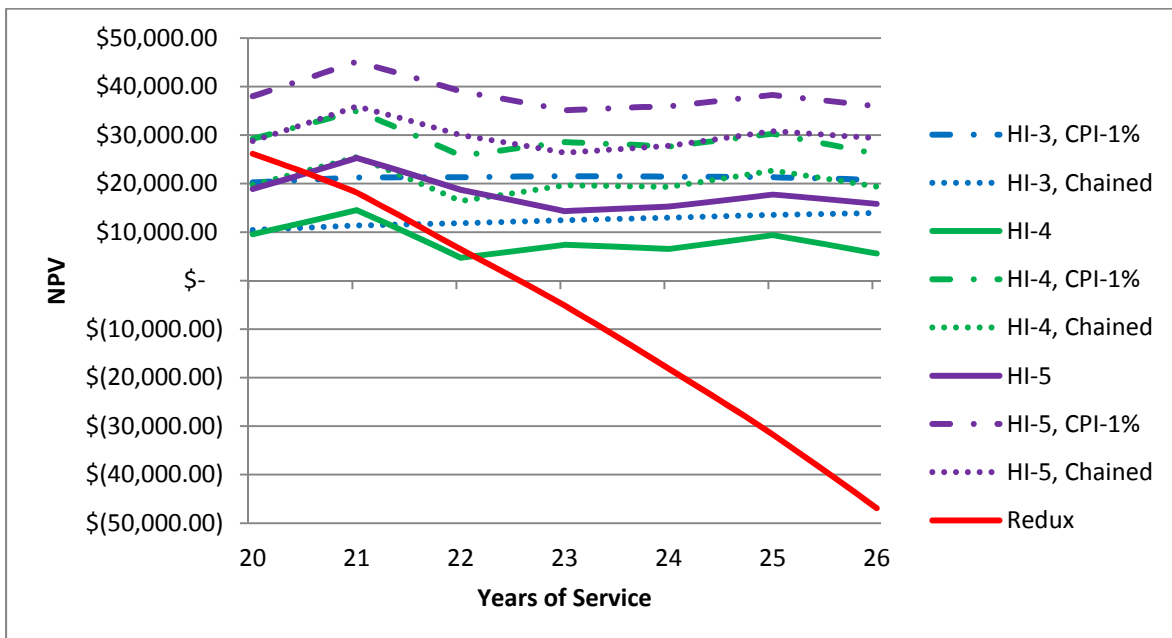


Figure 26. E-8 Difference from HI-3 at 10.05 percent Discount Rate

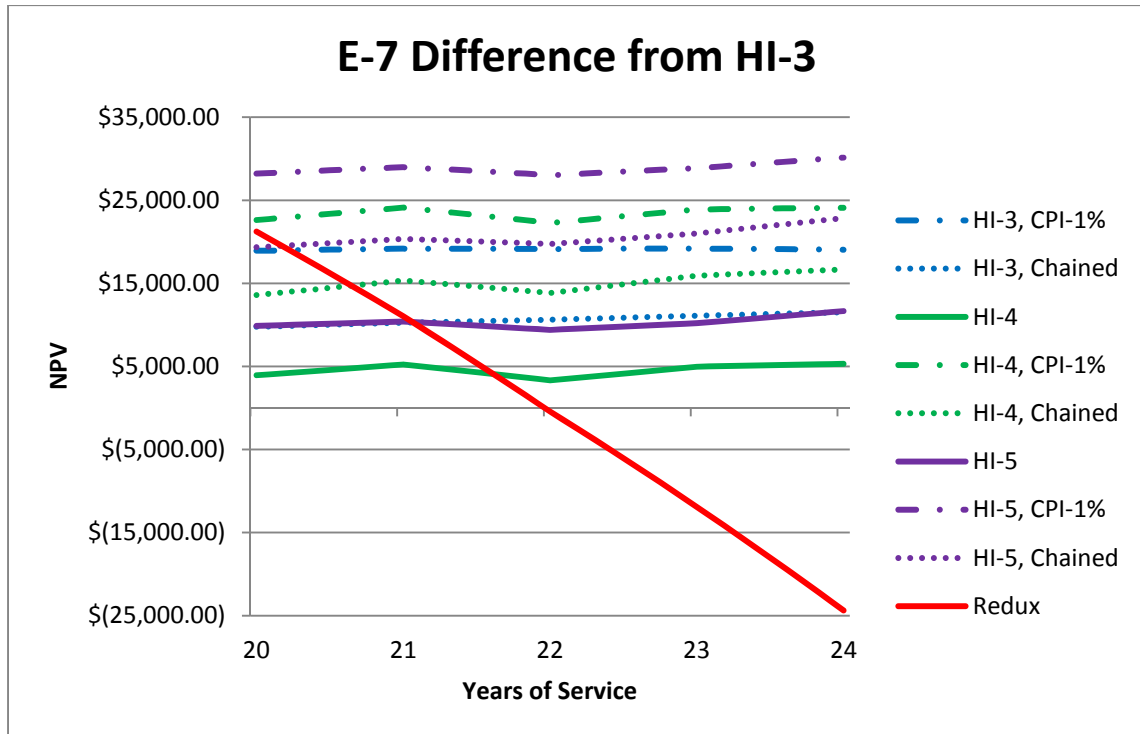


Figure 27. E-8 Difference from HI-3 at 10.05 percent Discount Rate

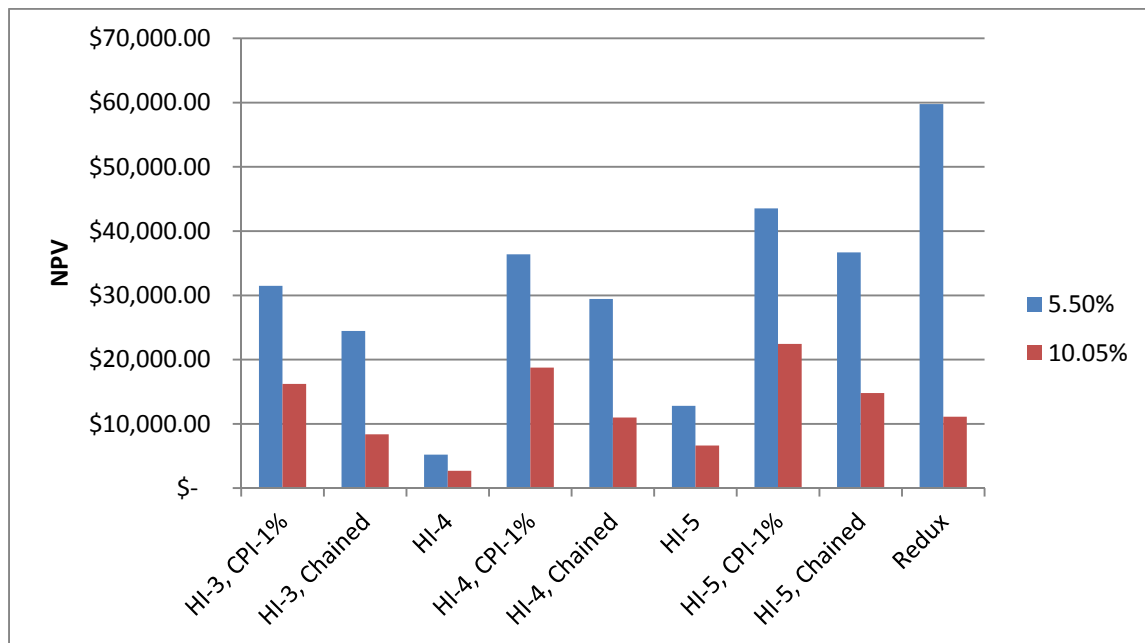


Figure 28. E-6 Difference form HI-3 at 20 Years of Service

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APPENDIX B. MATLAB CODE

A. MAIN.M

```
clc
clear
clearvars

c = 3; %what tab of input excel sheet to use
[vars]=inputs(c);
[pc09, pc10, pc11, pc12, pc13, pc14]=inputpay();

for x=1: size(vars, 2);

    pg = vars(1, x);           % pay grade at retirement
    sm = vars(2, x);           % number of months of service
    promotion = vars(3, x);     % month of last promotion
    d = vars(4, x);             % discount rate
    mr = 1;                     %month of retirement
    cpi = 0.03;                 %cpi rate
    chained = 0.027;            %chained cpi
    bm = 0.025;                 % percentage per year of service

    [pay3, pay4, pay5]=pay(pg, sm, promotion, mr);

    [hi3(x), hi4(x), hi5(x), rd(x)]=finalpay(pay3, pay4, pay5, pc09, pc10, pc11, pc12, pc13, pc14, bm, sm)
;

    [instalments, paymentnumber]=payments(hi3(x), hi4(x), hi5(x), rd(x), sm, pg, cpi, chained, mr);
    [total] = npv(instalments, paymentnumber, d, sm);

    npvx(:, x) = total;

    [npvd] = difference(npvx);
end

outputs(vars, npvx, npvd);
```

B. INPUTS.M

```
function [vars]=inputs(x)
%this fuction selects the input matrix
if x == 1
    vars=xlsread('variables.xlsx', '06');
elseif x==2
    vars=xlsread('variables.xlsx', '05');
```

```

el sei f x==3
    vars=xl sread(' vari abl es. xl sx' , ' 05Di scount' );
el sei f x==4
    vars=xl sread(' vari abl es. xl sx' , ' 04' );
el sei f x==5
    vars=xl sread(' vari abl es. xl sx' , ' E9' );
el sei f x==6
    vars=xl sread(' vari abl es. xl sx' , ' E8' );
el sei f x==7
    vars=xl sread(' vari abl es. xl sx' , ' E7' );
el sei f x==8
    vars=xl sread(' vari abl es. xl sx' , ' E7Di scount' );
el sei f x==9
    vars=xl sread(' vari abl es. xl sx' , ' E6' );
el se
    vars=xl sread(' vari abl es. xl sx' , ' 06test' );
end

```

C. INPORTPAY.M

```

function [pc09, pc10, pc11, pc12, pc13, pc14]=i nportpay()
%this fuction imports the pay tables from excel

pc09=xl sread(' PayTabl es. xl sx' , ' 09' );
pc10=xl sread(' PayTabl es. xl sx' , ' 10' );
pc11=xl sread(' PayTabl es. xl sx' , ' 11' );
pc12=xl sread(' PayTabl es. xl sx' , ' 12' );
pc13=xl sread(' PayTabl es. xl sx' , ' 13' );
pc14=xl sread(' PayTabl es. xl sx' , ' 14' );

```

D. PAY.M

```

function [pay3, pay4, pay5]=pay(pg, sm, promoti on, mr)
%this function calculates the pay chart, paygrade and years of service for
%each month need to calculate monthly retirement pay for 2014 for hi -3,
%hi -4, and hi -5. it returns an array with the first column being paychart,
%second column paygrad, and third column being years of service

q = pg; %holder for intial pg

for z = 1:3
    if z == 1
        y = 36;
    el sei f z==2

```



```

    y = 48;
else
    y = 60;
end

for n = 1:y
    x = sm-(n-1); %total months of service working backwards

    %this section is used to select the appropriate pay table and returns
    %it to column one of pay5
    if n<=mr
        chart = 14;
    elseif n<=mr+12
        chart = 13;
    elseif n<=mr+24
        chart = 12;
    elseif n<=mr+36
        chart = 11;
    elseif n<=mr+48
        chart = 10;
    else
        chart = 9;
    end

    if z == 1
        pay3(n, 1)= chart;
    elseif z==2
        pay4(n, 1)= chart;
    else
        pay5(n, 1)= chart;
    end

    %changes paygrade if member was promoted in last 36 months and puts
    %paygrade into column 2 of pay5.
    if x == promotion
        pg = pg+1;
    else
        pg = pg;
    end

    if z == 1
        pay3(n, 2)= pg;
    elseif z==2
        pay4(n, 2)= pg;
    else
        pay5(n, 2)= pg;
    end

    %checks years of service for corrcet pay ammonut and puts into column

```

```

%3 of pay5

s = x/12; %converts months to years
if s > 40
    pay = 14;
elseif s > 38
    pay = 13;
elseif s > 36
    pay = 12;
elseif s > 34
    pay = 11;
elseif s > 32
    pay = 10;
elseif s > 30
    pay = 9;
elseif s > 28
    pay = 8;
elseif s > 26
    pay = 7;
elseif s > 24
    pay = 6;
elseif s > 22
    pay = 5;
elseif s > 20
    pay = 4;
elseif s > 18
    pay = 3;
elseif s > 16
    pay = 2;
else
    pay = 1;
end

if z == 1
    pay3(n, 3) = pay;
elseif z == 2
    pay4(n, 3) = pay;
else
    pay5(n, 3) = pay;
end
end
pg=q; %resets pg for next loop to original
end

```

E. FINALPAY.M

```

function [hi 3, hi 4, hi 5, rd] = finalpay(pay3, pay4, pay5, pc09, pc10, pc11, pc12, pc13, pc14, bm, sm)
%This fuction computes the monthly pay for retirement

%finds retirement multiplier

```

```

ys = sm/12;
fm = ys*bm;

%hi -3 calculation
paycum3 = 0; %set up placeholder
for x =1:36
    pay = pay3(x,:);
    if pay(1) == 14
        mpay = pc14(pay(2), pay(3));
    elseif pay(1) == 13
        mpay = pc13(pay(2), pay(3));
    elseif pay(1) == 12
        mpay = pc12(pay(2), pay(3));
    elseif pay(1) == 11
        mpay = pc11(pay(2), pay(3));
    elseif pay(1) == 10
        mpay = pc10(pay(2), pay(3));
    elseif pay(1) == 9
        mpay = pc09(pay(2), pay(3));
    end
    paycum3 = paycum3 + mpay;
end
hi 3 = paycum3/36*fm;

%Redux Calculation
if ys <= 30
    rdm =0.4+(ys-20)*0.035;
else
    rdm =0.75+(ys-30)*0.025;
end
rd = paycum3/36*rdm;

%hi -4 calculation
paycum4 = 0; %set up placeholder
for x =1:48
    pay = pay4(x,:);
    if pay(1) == 14
        mpay = pc14(pay(2), pay(3));
    elseif pay(1) == 13
        mpay = pc13(pay(2), pay(3));
    elseif pay(1) == 12
        mpay = pc12(pay(2), pay(3));
    elseif pay(1) == 11
        mpay = pc11(pay(2), pay(3));
    elseif pay(1) == 10
        mpay = pc10(pay(2), pay(3));
    elseif pay(1) == 9
        mpay = pc09(pay(2), pay(3));
    end
    paycum4 = paycum4 + mpay;
end
hi 4 = paycum4/48*fm;

```

```

%hi -5 calculation
paycum5 = 0; %set up placeholder
for x =1:60
    pay = pay5(x,:);
    if pay(1) == 14
        mpay = pc14(pay(2), pay(3));
    elseif pay(1) == 13
        mpay = pc13(pay(2), pay(3));
    elseif pay(1) == 12
        mpay = pc12(pay(2), pay(3));
    elseif pay(1) == 11
        mpay = pc11(pay(2), pay(3));
    elseif pay(1) == 10
        mpay = pc10(pay(2), pay(3));
    elseif pay(1) == 9
        mpay = pc09(pay(2), pay(3));
    end
    paycum5 = paycum5 + mpay;
end
hi 5 = paycum5/60*fm;

```

F. PAYMENTS.M

```

function [installments, paymentnumber] = payments(hi 3, hi 4, hi 5, rd, sm, pg, cpi, chained, mr)
%calculates payments paid out to the member over the life of their
%retirement
%returns the number of payments they will receive and an array with the
%actually monthly payments
%the rows are as follows
%row 1 - hi 3 current
%row 2 - hi 3 cpi - 1%
%row 3 - hi 3 chained cpi
%row 4 - hi 4 current
%row 5 - hi 4 cpi - 1%
%row 6 - hi 4 chained cpi
%row 7 - hi 5 current
%row 8 - hi 5 cpi - 1%
%row 9 - hi 5 chained cpi

%assumes officers joined at 22 and enlisted joined at 18. Ages are in
%months
age0 = 264;
ageE= 216;
life0 = 84.5*12;
lifeE = 80.5*12;

if pg<=7
    age = age0;
    life = life0;

```

```

else
    age = ageE;
    life = lifeE;
end

paymentnumber = life -(sm+age); % expected monthly payments made to retire
secondcarrerpayments = 62*12-(sm+age); %number of payments until 62
start = 12-mr;

for x = 1:3;
    if x==1
        hi n = hi 3;
        hi cpi = hi 3;
        hi chained = hi 3;
        t=0;
    elseif x==2
        hi n = hi 4;
        hi cpi = hi 4;
        hi chained = hi 4;
        t=3;
    else
        hi n = hi 5;
        hi cpi = hi 5;
        hi chained = hi 5;
        t=6;
    end
    %section produce the payments for orginial system
    y = 1; %counter variable
    for z = 1:paymentnumber;
        if y < start;
            instal lments(t+1,z) = hi n;
            y = y+1;
        elseif y >= start + 12;
            hi n = hi n*(1+cpi);
            instal lments(t+1,z) = hi n;
            y = y-11;
        else
            instal lments(t+1,z) = hi n;
            y = y+1;
        end
    end
end

%section produces payments for cpi - 1%
y = 1; %reset counter variable
for z = 1:paymentnumber;
    if z < secondcarrerpayments;
        if y < start;
            instal lments(t+2,z) = hi cpi ;
            y = y+1;
        elseif y >= start + 12;
            hi cpi = hi cpi *(1+cpi -0.01);
            instal lments(t+2,z) = hi cpi ;
        end
    end
end

```

```

        y = y-11;
    else
        installments(t+2,z) = hi cpi ;
        y = y+1;
    end
else
    hi cpi = installments(t+1,z);
    if y < start;
        installments(t+2,z) = hi cpi ;
        y = y+1;
    elseif y >= start + 12;
        hi cpi = hi cpi *(1+cpi);
        installments(t+2,z) = hi cpi ;
        y = y-11;
    else
        installments(t+2,z) = hi cpi ;
        y = y+1;
    end
end
end

%section produces payments for chained_cpi%
y = 1; %reset counter variable
for z = 1:paymentnumber;
    if y < start
        installments(t+3,z) = hi chained;
        y = y+1;
    elseif y >= start + 12;
        hi chained = hi chained*(1+chai ned);
        installments(t+3,z) = hi chained;
        y = y-11;
    else
        installments(t+3,z) = hi chained;
        y = y+1;
    end
end

end

%calculates redux value
y = 1; %reset counter variable
rdpay = rd;
for z = 1:paymentnumber;
    if z < secondcarrerpayments;
        if y < start;
            installments(t+4,z) = rdpay;
            y = y+1;
        elseif y >= start + 12;
            rdpay = rdpay*(1+cpi -0.01);
            installments(t+4,z) = rdpay;
            y = y-11;
        end
    end
end

```

```

        else
            installments(t+4,z) = rdpay;
            y = y+1;
        end
    else
        rdpay = installments(1,z);
        if y < start;
            installments(t+4,z) = rdpay;
            y = y+1;
        elseif y >= start + 12;
            rdpay = rdpay*(1+cpi-0.01);
            installments(t+4,z) = rdpay;
            y = y-11;
        else
            installments(t+4,z) = rdpay;
            y = y+1;
        end
    end
end
end

```

G. NPV.M

```

function [npv] = npv(payments, paymentnumber, d, sm)
%calculates NPV

for x = 1: paymentnumber
    npvp(:,x)=payments(:,x)/(1+d/12)^x;
end
npv = sum(npvp, 2);

lump = 30000;
t = sm-(15*12);
rdlump = lump*(1+d/12)^t;

npv(10,1)= npv(10,1)+rdlump;

```

H. DIFFERENCE.M

```

function [ npvd ] = difference(npvx)
%finds the difference between hi 3 and other plans

for x = 2: size(npvx, 1)
    npvd(x-1,:) = npvx(1,:)-npvx(x,:);
end
end

```

I. OUTPUTS.M

```
function outputs(vars, npvx, npvd)
% This fuction formats and writes the outputs to excel
a = {'Months';
     'HI -3';
     'HI -3, CPI -1%';
     'HI -3, Chai ned';
     'HI -4';
     'HI -4, CPI -1%';
     'HI -4, Chai ned';
     'HI -5';
     'HI -5, CPI -1%';
     'HI -5, Chai ned';
     'Redux';
     'di ffernce';
     'Months';
     'HI -3, CPI -1%';
     'HI -3, Chai ned';
     'HI -4';
     'HI -4, CPI -1%';
     'HI -4, Chai ned';
     'HI -5';
     'HI -5, CPI -1%';
     'HI -5, Chai ned';
     'Redux'};

b = num2cell([vars(2, :)/12;
              npvx(1, :);
              npvx(2, :);
              npvx(3, :);
              npvx(4, :);
              npvx(5, :);
              npvx(6, :);
              npvx(7, :);
              npvx(8, :);
              npvx(9, :);
              npvx(10, :);
              zeros(size(npvx(1, :)));
              vars(2, :)/12;
              npvd(1, :);
              npvd(2, :);
              npvd(3, :);
              npvd(4, :);
              npvd(5, :);
              npvd(6, :);
              npvd(7, :);
              npvd(8, :);
              npvd(9, :)]);
```



```
c = [a,b];  
xlswrite('outputs.xlsx', c, 'new');  
wipopen('outputs.xlsx');
```

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